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GRADE 12 DIPLOMA EXAMINATION

Chemistry 30

June 1988

Alberta
EDUCATION

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**GRADE 12 DIPLOMA EXAMINATION
CHEMISTRY 30**

DESCRIPTION

Time: 2½ hours

Total possible marks: 70

This is a **CLOSED-BOOK** examination consisting of two parts:

PART A: 56 multiple-choice questions each with a value of 1 mark.

PART B: Three written-response questions for a total of 14 marks.

A chemistry data booklet is provided for your reference. Approved calculators may be used.

GENERAL INSTRUCTIONS

Fill in the information on the answer sheet as directed by the examiner.

For multiple-choice questions, read each carefully and decide which of the choices **BEST** completes the statement or answers the question. Locate that question number on the answer sheet and fill in the space that corresponds to your choice. **USE AN HB PENCIL ONLY.**

Example	Answer Sheet
This examination is for the subject area of	A B C D
A. Chemistry	● ② ③ ④
B. Biology	
C. Physics	
D. Mathematics	

If you wish to change an answer, please erase your first mark completely.

For written-response questions, read each carefully, show all your calculations, and write your answer in the space provided in the examination booklet.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.
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DO NOT FOLD EITHER THE ANSWER SHEET OR THE EXAMINATION BOOKLET

The presiding examiner will collect the answer sheet and examination booklet for transmission to Alberta Education.

JUNE 1988

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PART A


INSTRUCTIONS

There are 56 multiple-choice questions with a value of one mark each in this section of the examination. Use the separate answer sheet provided and follow the specific instructions given.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

WHEN YOU HAVE COMPLETED PART A, PROCEED DIRECTLY TO PART B

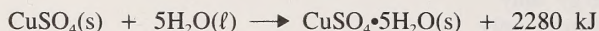
**DO NOT TURN THE PAGE TO START THE EXAMINATION UNTIL TOLD
TO DO SO BY THE PRESIDING EXAMINER**



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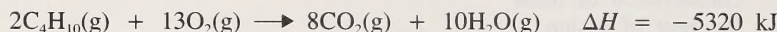
1. When water is heated from 10°C to 110°C, it undergoes a change in
- kinetic energy only
 - potential energy only
 - intramolecular bonding only
 - both kinetic and potential energy
2. The following statement which is NOT associated with phase changes is
- a constant temperature
 - a kinetic energy change
 - conservation of mass
 - the heat of fusion
3. Given the equation $\frac{1}{2}\text{N}_2(\text{g}) + \text{O}_2(\text{g}) + 33.8 \text{ kJ} \rightarrow \text{NO}_2(\text{g})$, which of the following statements concerning this reaction is TRUE?
- The heat of reaction will be negative.
 - The temperature of the system will rise.
 - Potential energy will be converted to kinetic energy.
 - Nitrogen dioxide will contain more potential energy than its elements.
4. Identify the FALSE statement about the following equation:
- $$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g}) \quad \Delta H = -483.6 \text{ kJ}$$
- The reaction is exothermic.
 - 483.6 kJ of heat are evolved per mole of O_2 used.
 - The heat of formation of water vapor is -241.8 kJ/mol .
 - 483.6 kJ of heat are evolved per mole of water produced.
5. Which of the following changes are involved in burning a candle?
- An exothermic chemical change and an endothermic phase change
 - An endothermic chemical change and an endothermic phase change
 - An endothermic chemical change and an exothermic phase change
 - An exothermic chemical change and an exothermic phase change

6. Given the equation for the reaction between $\text{CuSO}_4(\text{s})$ and $\text{H}_2\text{O}(\ell)$, what is the value of ΔH per mole of $\text{H}_2\text{O}(\ell)$?



- A. -2280 kJ/mol
- B. -456 kJ/mol
- C. $+456 \text{ kJ/mol}$
- D. $+2280 \text{ kJ/mol}$

7. Consider this equation and its heat of reaction.



An alternate way to express the same information is

- A. $\text{C}_4\text{H}_{10}(\text{g}) + \frac{13}{2}\text{O}_2(\text{g}) \longrightarrow 4\text{CO}_2(\text{g}) + 5\text{H}_2\text{O}(\text{g}) + 5320 \text{ kJ}$
- B. $2\text{C}_4\text{H}_{10}(\text{g}) + 13\text{O}_2(\text{g}) + 5320 \text{ kJ} \longrightarrow 8\text{CO}_2(\text{g}) + 10\text{H}_2\text{O}(\text{g})$
- C. $8\text{CO}_2(\text{g}) + 10\text{H}_2\text{O}(\text{g}) \longrightarrow 2\text{C}_4\text{H}_{10}(\text{g}) + 13\text{O}_2(\text{g}) + 5320 \text{ kJ}$
- D. $2\text{C}_4\text{H}_{10}(\text{g}) + 13\text{O}_2(\text{g}) \longrightarrow 8\text{CO}_2(\text{g}) + 10\text{H}_2\text{O}(\text{g}) + 5320 \text{ kJ}$

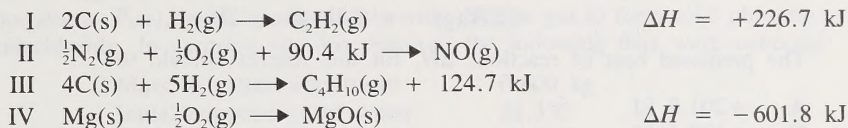
8. When the standard heats of formation of the hydrogen halides are compared in the order $\text{HF}(\text{g})$, $\text{HCl}(\text{g})$, $\text{HBr}(\text{g})$, and $\text{HI}(\text{g})$, a definite trend appears. One correct inference from such an observed trend could be that the

- A. hydrogen halides are ALL less stable than the constituent elements
- B. hydrogen halides are ALL more stable than the constituent elements
- C. H-F bond is the strongest of the hydrogen-halide bonds
- D. H-F bond is the weakest of the hydrogen-halide bonds

9. Each of the four reactions given below was allowed to occur one at a time in the same calorimeter, each starting at the same temperature. One mole of product was formed by each reaction. The final temperature of the system would be highest for the reaction

- A. $2\text{C}(\text{s}) + 3\text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_6(\text{g})$
- B. $\frac{1}{2}\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \longrightarrow \text{NO}(\text{g})$
- C. $\frac{1}{2}\text{H}_2(\text{g}) + \frac{1}{2}\text{I}_2(\text{s}) \longrightarrow \text{HI}(\text{g})$
- D. $\text{Hg}(\ell) + \frac{1}{2}\text{O}_2(\text{g}) \longrightarrow \text{HgO}(\text{s})$

Interpret the following information to answer question 10.



10. Which of the reactions are endothermic?

- A. I and II only
- B. I and III only
- C. II and III only
- D. III and IV only

11. Which change produces the most energy?

- A. The combustion of 1 mole of methane
- B. The fission of 0.1 mole of uranium
- C. The neutralization of 1 mole of acid
- D. The conversion of 10 moles of steam at 100°C to ice at -40°C

Use the following statements to answer question 12.

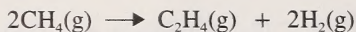
These statements deal with changes in matter and the related changes in energy.

- I Phase change energies relate to changes in intermolecular bonds.
- II The magnitude of stored energy increases as the state of a substance changes from a gas to a liquid.
- III Chemical changes involve energy changes which result mainly from the forming and breaking of bonds between molecules.
- IV The magnitude of the energy change for phase changes is generally smaller than the energy change for chemical changes.
- V Both phase changes and chemical changes may involve the absorption of energy to break bonds.

12. Which of the statements are true?

- A. I and IV only
- B. I, IV, and V
- C. I, II, and III
- D. II, III, and IV

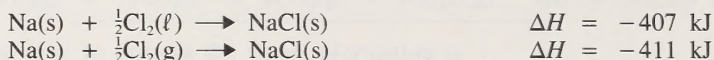
13. The following equation represents a simplification of a process for producing ethene from natural gas.



The predicted heat of reaction, ΔH , for this reaction should be

- A. +201.9 kJ
- B. +127.1 kJ
- C. -22.5 kJ
- D. -97.3 kJ

Use the following information to answer question 14.



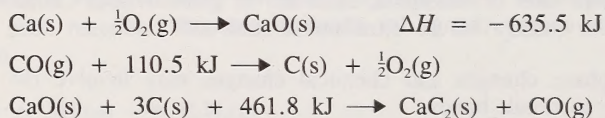
14. The 4 kJ difference in energy between the two heats of reaction is

- A. due to experimental error
- B. the heat needed to evaporate $\frac{1}{2}$ mol $\text{Cl}_2(\ell)$
- C. the heat required to melt 1 mol $\text{NaCl}(\text{s})$
- D. the net energy released when 2 mol $\text{NaCl}(\text{s})$ are formed

15. If complete combustion of 4.0 g of methane gas in a calorimeter causes the temperature of 5.0 kg of water to increase from 25.0°C to 35.5°C, then the heat of combustion of methane is

- A. $-8.8 \times 10^2 \text{ kJ/mol}$
- B. $-7.0 \times 10^2 \text{ kJ/mol}$
- C. $-1.8 \times 10^2 \text{ kJ/mol}$
- D. $-5.5 \times 10^1 \text{ kJ/mol}$

Interpret the following information to answer question 16.



16. The heat of formation for $\text{CaC}_2(\text{s})$ is

- A. +986.8 kJ/mol
- B. +284.2 kJ/mol
- C. -63.2 kJ/mol
- D. -1208 kJ/mol

Use the following recorded data to answer question 17.

Phosphorus, $P_4(s)$, reacts spontaneously with chlorine gas to form solid phosphorus pentachloride. In carrying out this reaction, the following data were collected:

Mass of calorimeter water	0.800 kg
Initial temperature of water	21.3°C
Final temperature of water	32.8°C
Mass of phosphorus	3.10 g
Mass of chlorine	excess

17. The experimental value for the heat of formation of $PCl_5(s)$ is

- A. -96.4 kJ/mol
 - B. -385 kJ/mol
 - C. -399 kJ/mol
 - D. -1540 kJ/mol
-

Use the following data to answer question 18.

A student prepared the following data table prior to an investigation:

<u>Trial number</u>	1	2	3
Mass of $NaOH(s)$ to be dissolved	2.0 g	4.0 g	6.0 g
Mass $H_2O(l)$ as solvent	100 g	100 g	100 g
Initial temperature of water ($^{\circ}C$)	—	—	—
Final temperature of water ($^{\circ}C$)	—	—	—

18. Choose the hypothesis which should NOT be tested with the completed data:

- A. Heat will be lost by the water during dissolving.
 - B. The dissolving of $NaOH(s)$ is an endothermic process.
 - C. The molar heat of solution depends upon dissolving time.
 - D. The molar heat of solution depends upon the mass of $NaOH(s)$ used.
-

19. A similarity between solutions of a strong acid and a strong base is that both solutions

- A. taste sour
- B. are slippery
- C. conduct electricity
- D. turn blue litmus red

20. A mechanic is trying to clean up a spill from a leaky car battery. What common substance should be used to neutralize the effects of the spill?
- A. Water
 - B. Vinegar
 - C. Lemon juice
 - D. Baking soda
21. A 10.0 mol/L solution of CH_3COOH is best described as a
- A. dilute weak acid
 - B. dilute strong acid
 - C. concentrated weak acid
 - D. concentrated strong acid
22. Which one of the following species would increase the $[\text{H}_3\text{O}^+(\text{aq})]$ of water?
- A. $\text{NH}_3(\text{aq})$
 - B. $\text{CH}_3\text{OH}(\ell)$
 - C. $\text{HCOOH}(\text{aq})$
 - D. $\text{Ba}(\text{OH})_2(\text{aq})$
23. Identify the two acids in the equation
 $\text{H}_2\text{O}(\ell) + \text{HPO}_4^{2-}(\text{aq}) \rightleftharpoons \text{H}_2\text{PO}_4^-(\text{aq}) + \text{OH}^-(\text{aq})$.
- A. $\text{OH}^-(\text{aq})$ and $\text{HPO}_4^{2-}(\text{aq})$
 - B. $\text{H}_2\text{O}(\ell)$ and $\text{H}_2\text{PO}_4^-(\text{aq})$
 - C. $\text{H}_2\text{O}(\ell)$ and $\text{HPO}_4^{2-}(\text{aq})$
 - D. $\text{H}_2\text{O}(\ell)$ and $\text{OH}^-(\text{aq})$
24. A solution of 0.100 mol/L $\text{NaHCO}_3(\text{aq})$ was prepared and tested with a calibrated pH meter. The pH was determined to be 8.4. Which of the following equations best represents the reaction which occurs when $\text{HCO}_3^-(\text{aq})$ reacts with water?
- A. $\text{NaHCO}_3(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{NaOH}(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$
 - B. $\text{H}_2\text{CO}_3(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{HCO}_3^-(\text{aq})$
 - C. $\text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + \text{OH}^-(\text{aq})$
 - D. $\text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$

25. The process of removing hydrogen ions from a solution by adding an equal number of hydroxide ions is called
- hydration
 - ionization
 - hydrolysis
 - neutralization
26. In a 0.10 mol/L solution of HCN(aq) , which of the following species will be present in greatest concentration?
- $\text{H}_3\text{O}^+(\text{aq})$ and $\text{CN}^-(\text{aq})$
 - HCN(aq) and $\text{CN}^-(\text{aq})$
 - $\text{H}_3\text{O}^+(\text{aq})$
 - HCN(aq)
27. To determine the pH of an unknown solution, a student used the following indicator information.

Indicator	pH Range and Color Range
W	3.2 red – 4.4 yellow
X	4.8 red – 6.0 yellow
Y	6.0 yellow – 7.6 blue
Z	8.2 colorless – 10.0 pink

Each indicator was added to 10 mL portions of the unknown solution. The results were as follows:

Test Tube Number	Indicator	Color
1	W	yellow
2	X	yellow
3	Y	blue
4	Z	colorless

The most probable pH of the unknown solution would be

- 5
- 6
- 7
- 8

28. What is the hydroxide ion concentration in a 0.15 mol/L nitric acid solution?

- A. 1.5×10^{-1} mol/L
- B. 1.5×10^{-13} mol/L
- C. 6.7×10^{-13} mol/L
- D. 6.7×10^{-14} mol/L

29. The pH of a solution is 4.80. The TRUE statement about this solution is that it is

- A. acidic with $[\text{H}_3\text{O}^+(\text{aq})] > 10^{-7}$ mol/L
- B. acidic with $[\text{H}_3\text{O}^+(\text{aq})] < 10^{-7}$ mol/L
- C. basic with $[\text{OH}^-(\text{aq})] < 10^{-7}$ mol/L
- D. basic with $[\text{OH}^-(\text{aq})] > 10^{-7}$ mol/L

Use the following observations to answer question 30.

<u>Solution</u>	<u>Observations</u>
Solution I	a large pH; conducts electricity
Solution II	turns litmus blue; forms an aqueous solution having a low conductivity
Solution III	conducts electricity; reacts with Zn(s) to form $\text{H}_2(\text{g})$
Solution IV	has a small pH; turns pink when phenolphthalein is added

30. A student made one error in recording observations on four unknown solutions. For which solution did the error occur?

- A. I
 - B. II
 - C. III
 - D. IV
-

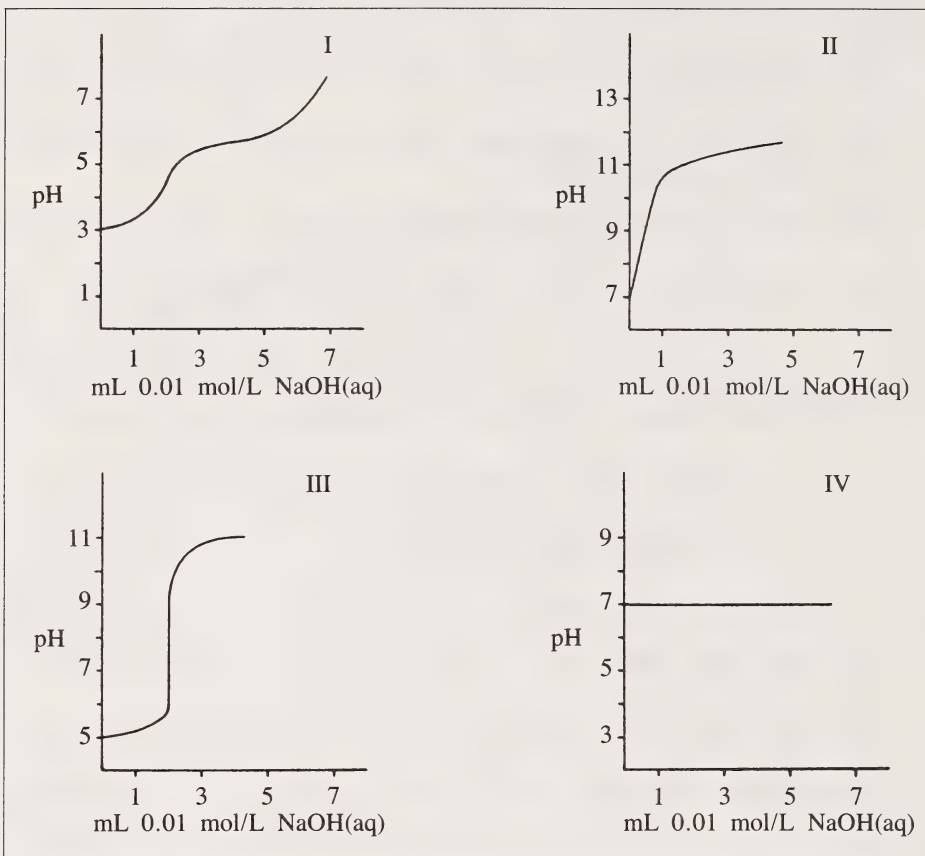
31. A student prepared a solution containing acetic acid and sodium acetate. If a few drops of a strong acid were added, then the
- A. pH would remain approximately constant because the acetic acid would react with the added $\text{H}_3\text{O}^+(\text{aq})$
 - B. pH would remain approximately constant because the acetate ion would react with the added $\text{H}_3\text{O}^+(\text{aq})$
 - C. pH would be raised due to the added $\text{H}_3\text{O}^+(\text{aq})$
 - D. pH would be 7 because the solution would be buffered
32. A standard solution of $\text{KOH}(\text{aq})$ was used to titrate an unknown solid acid sample (HA) until the endpoint was reached. The following data were obtained:

Mass of acid in sample	0.25 g
Concentration of standard $\text{KOH}(\text{aq})$	0.100 mol/L
Initial buret reading $\text{KOH}(\text{aq})$	0.50 mL
Final buret reading $\text{KOH}(\text{aq})$	29.64 mL

The molar mass of the unknown acid is

- A. $8.3 \times 10^1 \text{ g/mol}$
- B. $8.6 \times 10^1 \text{ g/mol}$
- C. $2.5 \times 10^2 \text{ g/mol}$
- D. $8.6 \times 10^3 \text{ g/mol}$

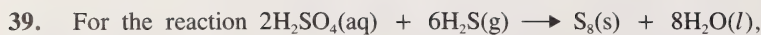
Use the following graphs to answer question 33.



33. When NaOH(aq) is added progressively to an unknown solution, the graph that would best indicate that the unknown solution could be NaCl(aq) is

- A. I
- B. II
- C. III
- D. IV

34. 20.0 mL of a solution labelled 0.10 mol/L NaOH(aq) was titrated with 20.0 mL of a solution labelled 0.10 mol/L HCl(aq). The resulting solution was tested with a pH meter which gave a reading of 8.0. Which statement identifies the most probable error in the experiment?
- A. The volume of HCl(aq) was actually higher than 20.0 mL.
 - B. The volume of NaOH(aq) was actually lower than 20.0 mL.
 - C. The concentration of HCl(aq) was actually higher than 0.10 mol/L.
 - D. The concentration of NaOH(aq) was actually higher than 0.10 mol/L.
35. A 20.5 mL sample of NH₃(aq) was titrated to an endpoint using 30.3 mL of HBr(aq) with a pH of 1.65. The [NH₃(aq)] in the sample is
- A. 1.5×10^{-2} mol/L
 - B. 3.3×10^{-2} mol/L
 - C. 1.5×10^{-1} mol/L
 - D. 3.3×10^{-1} mol/L
36. If 20 mL of a 0.10 mol/L solution of an acid reacted completely with 40 mL of a 0.10 mol/L solution of NaOH(aq), a probable interpretation should be that the
- A. acid is diprotic
 - B. acid is stronger than the base
 - C. base is less dissociated than the acid
 - D. acid is more concentrated than the base
37. During an experiment to determine the relative strengths of acids, 8.0 g HF dissolved in 2.0 L of water, yielding a pH of 2.08. Using these data, the per cent ionization of this acid is
- A. 20%
 - B. 9.0%
 - C. 5.9%
 - D. 4.2%
38. For the reaction $2\text{Ag}^+(\text{aq}) + \text{Cd}(\text{s}) \longrightarrow \text{Cd}^{2+}(\text{aq}) + 2\text{Ag}(\text{s})$, the substance being oxidized is
- A. Cd²⁺(aq)
 - B. Ag⁺(aq)
 - C. Cd(s)
 - D. Ag(s)



- A. sulfur is oxidized and hydrogen is reduced
- B. hydrogen is oxidized and oxygen is reduced
- C. sulfur is oxidized and oxygen is oxidized
- D. sulfur is both oxidized and reduced

Use the following information to answer question 40.

<u>Element #</u>	<u>Color of Metal</u>	<u>Color of Ion</u>
1	red	orange
2	blue	green
3	pink	salmon

Assume that this table was compiled by a scientist who had just discovered three new metallic elements. In trying to find the most reactive metal, it was observed that when the red solid was placed in the green colored ionic solution a blue solid formed. Also, the pink metal retained its color in both the green and the orange colored ionic solutions.

40. The color of the most reactive metal is

- A. red
- B. blue
- C. pink
- D. orange

41. Iron will corrode when exposed to moist air. A properly balanced redox equation that illustrates this is

- A. $2\text{Fe}(\text{s}) + \text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{Fe}(\text{OH})_2(\text{s})$
- B. $2\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{Fe}(\text{OH})_3(\text{s})$
- C. $\text{Fe}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{Fe}(\text{OH})_2(\text{s}) + \text{H}_2(\text{g})$
- D. $\text{Fe}(\text{s}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$

42. During the reaction $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$, carbon changes in oxidation state

- A. from 0 to +4 and oxygen changes from 0 to -2
- B. from +2 to +4 and oxygen changes from 0 to -2
- C. from -1 to +4 and oxygen changes from -2 to 0
- D. from 0 to +4 and oxygen changes from -2 to 0

43. In the reaction between iron and bromine, each atom of iron changes oxidation number from 0 to +3 and each atom of bromine changes oxidation number from 0 to -1. The balanced net equation for this redox reaction is
- A. $\text{Fe(s)} + \text{Br}_2(\text{aq}) \longrightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{Br}^{-}(\text{aq})$
B. $2\text{Fe(s)} + 3\text{Br}_2(\text{aq}) \longrightarrow 2\text{Fe}^{3+}(\text{aq}) + 6\text{Br}^{-}(\text{aq})$
C. $2\text{Fe}^{2+}(\text{aq}) + \text{Br}_2(\text{aq}) \longrightarrow 2\text{Fe}^{3+}(\text{aq}) + 2\text{Br}^{-}(\text{aq})$
D. $2\text{Fe}^{3+}(\text{aq}) + \text{Br}_2(\text{aq}) \longrightarrow 2\text{Fe}^{2+}(\text{aq}) + 2\text{Br}^{-}(\text{aq})$

Use the following information to answer question 44.

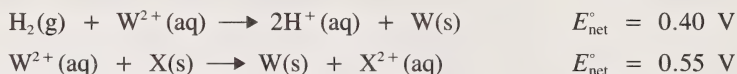
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|-----|---|
| I | An oxidizing agent gains electrons |
| II | Conversion of bromine gas to bromide ions |
| III | Formation of gold ions from gold metal |
| IV | Change of an oxidation number from -2 to -3 |

44. Which of the above are examples of reduction?
- A. II, III, IV
B. I, III, IV
C. I, II, III
D. I, II, IV
-
45. In an electrochemical cell utilizing lead metal and silver ions, a student found that the mass of lead that reacted was 2.40 g. The mass of silver metal that formed at the same time would be
- A. 1.25 g
B. 2.40 g
C. 2.50 g
D. 4.81 g
46. Which statement about a reduction potential is FALSE?
- A. The oxidation potential for a half-reaction is the negative of its reduction potential.
B. The reduction potential of an electrochemical cell is dependent on the number of electrons transferred.
C. Reduction potentials are obtained by comparing each half-cell reaction to a standard hydrogen half-cell.
D. A positive reduction potential implies that a substance has a greater tendency to attract electrons than does a hydrogen ion.

47. By referring to E° values, a student predicted that selenium would oxidize aluminum and sodium but not chromium or iron. A possible E° value for the reduction of selenium is
- A. -0.33 V
 - B. -0.60 V
 - C. -0.78 V
 - D. -1.72 V

Interpret the following observations to answer question 48.

A student collected data for reactions using hydrogen and two unidentified metals labelled X(s) and W(s).



48. What is the standard reduction potential for the reaction $\text{X}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{X}(\text{s})$?
- A. -0.95 V
 - B. -0.15 V
 - C. $+0.15 \text{ V}$
 - D. $+0.95 \text{ V}$
-

Use the following data to answer question 49.

The following data were obtained in an experiment to determine the solubility of $\text{PbCl}_2(\text{s})$. In the experiment, pieces of pure zinc were added to a saturated solution of $\text{PbCl}_2(\text{aq})$. The mass of zinc before the experiment was 12.9 g. The mass of zinc after the experiment was 10.5 g.

49. Using a table of E° values, which of the following metals (aluminum, copper, and nickel) should be predicted to react in a similar manner to zinc in this experiment?
- A. Copper only
 - B. Aluminum only
 - C. Aluminum and nickel
 - D. Aluminum, copper, and nickel
-

50. A student who was asked to identify the metallic ion present in an unknown sample of solution was given three metallic strips: Cr(s), Al(s), Mg(s). When the chromium strip was placed in the unknown solution, no reaction occurred; however, the aluminum and magnesium strips both caused a reaction. The unknown solution most likely is
- A. $\text{Ca}(\text{NO}_3)_2(\text{aq})$
 - B. $\text{Cu}(\text{NO}_3)_2(\text{aq})$
 - C. $\text{Zn}(\text{NO}_3)_2(\text{aq})$
 - D. $\text{Fe}(\text{NO}_3)_2(\text{aq})$
51. The net potential generated by the reaction of Cu(s) with acidified $\text{MnO}_4^- (\text{aq})$ is
- A. 0.64 V
 - B. 1.15 V
 - C. 1.28 V
 - D. 1.83 V
52. Using the table of reduction half-reactions, a spontaneous redox reaction could be predicted to occur if the
- A. oxidizing agent is located above the reducing agent
 - B. E_{net}° for the oxidation-reduction potential has a negative value
 - C. number of electrons lost balances the number of electrons gained
 - D. oxidation half-reaction is located above the reduction half-reaction
53. A shiny Cu(s) strip is placed in a blue $\text{CuSO}_4(\text{aq})$ solution in a porous cup which is then placed into a beaker of $\text{ZnSO}_4(\text{aq})$ solution. A shiny Zn(s) strip is placed in the $\text{ZnSO}_4(\text{aq})$. The solution in the beaker starts turning blue immediately. When a voltmeter is connected between the Cu(s) and Zn(s) electrodes, the reading is almost zero. Based on these observations, the most probable reason for such a low voltage is that the
- A. predicted net voltage for this reaction is 0 volts
 - B. copper and zinc strips were not clean and therefore did not react in the solution
 - C. porous cup was cracked, allowing the solutions to mix before a reading was possible
 - D. mixed solutions were too concentrated in $\text{SO}_4^{2-}(\text{aq})$ ions for a reaction to occur

54. The purpose of the salt bridge or porous cup in an electrochemical cell is to
- A. allow electrons to move between the two half-cells
 - B. allow ions to move between the two half-cells
 - C. prevent contact between the electrodes of the two half-cells
 - D. distinguish the difference between the potentials for the two half-cells
55. Which of the following ions will need the largest quantity of electricity to deposit 200 g of the metal?
- A. Ca^{2+}
 - B. Cu^{2+}
 - C. Na^{+}
 - D. Ag^{+}
56. An iron and nickel alloy surface will corrode if left exposed to the rain. However, the rate of corrosion is decreased if a bar of metal that corrodes more readily is bolted to the surface. Among the following metals, the most effective anti-corrosion bar is
- A. Mg(s)
 - B. Cd(s)
 - C. Cu(s)
 - D. Ni(s)

YOU HAVE NOW COMPLETED THE MULTIPLE-CHOICE SECTION OF THE EXAMINATION. PLEASE PROCEED TO THE NEXT PAGE AND ANSWER THE WRITTEN-RESPONSE QUESTIONS IN PART B.

PART B

INSTRUCTIONS

Please write your answers in the examination booklet as neatly as possible.

Marks will be awarded for pertinent explanations, calculations, formulas, and answers. Answers must be given to the appropriate number of significant digits.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

TOTAL MARKS: 14

START PART B IMMEDIATELY

(5 marks)

1. For the experimental determination of the heat of combustion for an unidentified liquid, a chemistry class was divided into four groups. The class results were as follows.

<u>Group</u>	<u>Mass of Liquid Burned (g)</u>	<u>Calculated Heat Released (kJ)</u>
A	3.40	92.5
B	2.90	75.7
C	3.60	96.1
D	3.50	95.8

All the products of the combustion were in the vapor state. The students concluded that the liquid may be ethanol. Agree or disagree with their conclusion. Support your answer with relevant calculations and state the basis for your agreement or disagreement.

(4 marks)

2. A lab technician prepared several 0.10 mol/L solutions and forgot to label them. In an attempt to identify the solutions, their pH was measured and recorded as follows.

<u>Solution</u>	<u>pH</u>	<u>Possible Solutions</u>
I	11.6	NaCl(aq); C ₆ H ₅ COOH(aq)
II	2.6	Na ₂ CO ₃ (aq); HNO ₃ (aq)
III	13.0	LiOH(aq); Ba(OH) ₂ (aq)
IV	7.0	
V	1.0	
VI	13.3	

Identify each solution and give your reason for each choice based on the data provided.

(5 marks)

3. A potassium permanganate solution is purple even when very dilute. The $\text{Mn}^{2+}(\text{aq})$ ion is colorless for all practical purposes. Solutions of tin salts are colorless. 0.100 mol/L permanganate solution is added drop by drop to acidified $\text{SnCl}_2(\text{aq})$ and stirred. When 24.0 mL of permanganate solution is added, the first permanent purple color appears in the beaker of $\text{SnCl}_2(\text{aq})$. The concentration of $\text{Sn}^{2+}(\text{aq})$ ions is to be found.

a. Write the balanced net ionic equation.

- b. If the volume of the $\text{SnCl}_2(\text{aq})$ used was 1.00×10^2 mL, find the concentration of the $\text{Sn}^{2+}(\text{aq})$.

**YOU HAVE NOW COMPLETED THE EXAMINATION. IF YOU HAVE TIME,
YOU MAY WISH TO GO BACK AND CHECK YOUR ANSWERS.**

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

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FOR DEPARTMENT USE ONLY

M1

M2

M3

M4

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CHEMISTRY 30

(LAST NAME)

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(FIRST NAME)

DATE OF BIRTH:

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